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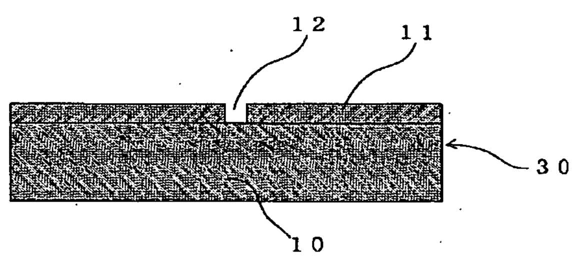
(54)【発明の名称】　燃料電池用セパレータおよびその製造方法および燃料電池

(57)【要約】
【課題】　燃料電池用セパレータの耐食性を向上し、燃料電池の耐久性を向上する。
【解決手段】　電解質１を挟持する一対の電極２ａ、２ｂの該電解質１と背向する一対の金属製の燃料電池用セパレータ３ａ、３ｂ、３０において、少なくとも一部の表面に耐食性被膜１１が形成され、該耐食性被膜１１に形成されたピンホール１２が封孔処理されていることを特徴とする燃料電池用セパレータ３ａ、３ｂ、３０及びその製造方法およびこの一対の燃料電池用セパレータ３ａ、３ｂ、３０で、電解質１を挟持する一対の電極２ａ、２ｂを挟んだことを特徴とする燃料電池２０。



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【特許請求の範囲】

【請求項１】　電解質を挟持する一対の電極の該電解質と背向する一対の金属製の燃料電池用セパレータにおいて、少なくとも一部の表面に耐食性被膜が形成され、該耐食性被膜に形成されたピンホールが封孔処理されていることを特徴とする燃料電池用セパレータ。

【請求項２】　金属材料から燃料電池用セパレータ基材形状を形成する形状加工工程と、該燃料電池用セパレータ基材の少なくとも一部の表面に耐食性被膜を形成する被覆工程と、該耐食性被膜に形成されたピンホールを封孔処理する封孔工程からなることを特徴とする燃料電池用セパレータの製造方法。

【請求項３】　前記封孔工程が、前記ピンホールを樹脂で封止する工程であることを特徴とする請求項２記載の燃料電池用セパレータの製造方法。

【請求項４】　前記耐食性被膜が延性を有する材料から形成され、前記封孔工程が前記耐食性被膜をローラ加圧によりピンホールを押しつぶす工程であることを特徴とする請求項２記載の燃料電池用セパレータの製造方法。

【請求項５】　前記封孔工程が、前記燃料電池用セパレータ基材を酸化して酸化被膜を形成し、ピンホールのセパレータ基材を酸化被膜で覆う工程であることを特徴とする請求項２記載の燃料電池用セパレータの製造方法。

【請求項６】　請求項１～５に記載の一対の燃料電池用セパレータで、電解質を挟持する一対の電極を挟んだことを特徴とする燃料電池。

【発明の詳細な説明】

【０００１】

【発明の属する技術分野】本発明は燃料電池用セパレータおよびその製造方法および燃料電池に関する。

【０００２】

【従来の技術】大気の汚染をできる限り減らすために自動車の排ガス対策が重要になっており、その対策の一つとして電気自動車が使用されているが、充電設備や走行距離などの問題で普及に至っていない。

【０００３】燃料電池は、水素と酸素を使用して電気分解の逆反応で発電し、水以外の排出物がなくクリーンな発電装置として注目されており、前記燃料電池を使用した自動車が最も将来性のあるクリーンな自動車であると見られている。前記燃料電池の中でも固体高分子電解質型燃料電池が低温で作動するため自動車用として最も有望である。

【０００４】前記固体高分子電解質型燃料電池は、一般的に多数のセルが積層されており、該セルは、二つの電極（燃料極と酸化剤極）で固体高分子電解質膜を挟んで接合した固体高分子電解質膜と電極の接合体を、燃料ガスまたは酸化剤ガスのガス流路を有するセパレータで挟んだ構造をしている。

【０００５】前記燃料電池が広く普及する上で障害になっていることの一つにコストが高いという問題があり、

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燃料電池の主要構成部品である電極のコストをできる限り下げることは重要である。また、自動車等の車載用としては小型・軽量化が求められている。低コスト化、小型・軽量化のために、従来の緻密性カーボンセパレータの代わりに金属セパレータの実用化の研究開発が進められている。

【０００６】この金属セパレータに要求される性能として、電極との接触抵抗が低いこと、および耐食性に優れていることがある。この性能を実現するために、従来技術として、特開平６－３４９５０８号公報には、メッキ処理した金属製の二極板が開示されている。

【０００７】

【発明が解決しようとする課題】しかしながら、従来技術のように金属表面にメッキ処理を施したとしても微小なピンホールが生じることは不可避であり、このピンホール部から金属基材の腐食が生じ、耐食性に問題があった。

【０００８】本発明は上記課題を解決したもので、耐食性に優れた燃料電池用セパレータおよびその製造方法および耐久性に優れた燃料電池を提供する。

【０００９】

【課題を解決するための手段】上記技術的課題を解決するために、本発明の請求項１において講じた技術的手段（以下、第１の技術的手段と称する。）は、電解質を挟持する一対の電極の該電解質と背向する一対の金属製の燃料電池用セパレータにおいて、少なくとも一部の表面に耐食性被膜が形成され、該耐食性被膜に形成されたピンホールが封孔処理されていることを特徴とする燃料電池用セパレータである。

【００１０】上記第１の技術的手段による効果は、以下のようである。

【００１１】すなわち、封孔処理によりピンホールを塞ぐことができるので、このピンホールから燃料電池用セパレータ基材が腐食されることがなく、耐食性に優れた燃料電池用セパレータができる。

【００１２】上記技術的課題を解決するために、本発明の請求項２において講じた技術的手段（以下、第２の技術的手段と称する。）は、金属材料から燃料電池用セパレータ基材形状を形成する形状加工工程と、該燃料電池用セパレータ基材の少なくとも一部の表面に耐食性被膜を形成する被覆工程と、該耐食性被膜に形成されたピンホールを封孔処理する封孔工程からなることを特徴とする燃料電池用セパレータの製造方法である。

【００１３】上記第２の技術的手段による効果は、以下のようである。

【００１４】すなわち、封孔工程でピンホールを塞ぐことができるので、このピンホールから燃料電池用セパレータ基材が腐食されることがなく、耐食性に優れた燃料電池用セパレータができる。

【００１５】上記技術的課題を解決するために、本発明

の請求項３において講じた技術的手段（以下、第３の技術的手段と称する。）は、前記封孔工程が、前記ピンホールを樹脂で封止する工程であることを特徴とする請求項２記載の燃料電池用セパレータの製造方法である。

【００１６】上記第３の技術的手段による効果は、以下のようである。

【００１７】すなわち、安価な樹脂でピンホールを塞ぐことができるので、低コストの燃料電池用セパレータができる。

【００１８】上記技術的課題を解決するために、本発明の請求項４において講じた技術的手段（以下、第４の技術的手段と称する。）は、前記耐食性被膜が延性を有する材料から形成され、前記封孔工程が前記耐食性被膜をローラ加圧によりピンホールを押しつぶす工程であることを特徴とする請求項２記載の燃料電池用セパレータの製造方法である。

【００１９】上記第４の技術的手段による効果は、以下のようである。

【００２０】すなわち、耐食性被膜自身でピンホールを塞ぐことができるので、低コストの燃料電池用セパレータができる。

【００２１】上記技術的課題を解決するために、本発明の請求項５において講じた技術的手段（以下、第５の技術的手段と称する。）は、前記封孔工程が、前記燃料電池用セパレータ基材を酸化して酸化被膜を形成し、ピンホールのセパレータ基材を酸化被膜で覆う工程であることを特徴とする請求項２記載の燃料電池用セパレータの製造方法である。

【００２２】上記第５の技術的手段による効果は、以下のようである。

【００２３】すなわち、燃料電池用セパレータ基材を酸化した酸化被膜でピンホールを塞ぐことができるので、確実にピンホールを塞ぐことができ、耐食性に優れた燃料電池用セパレータができる。

【００２４】上記技術的課題を解決するために、本発明の請求項６において講じた技術的手段（以下、第６の技術的手段と称する。）は、請求項１～５に記載の一対の燃料電池用セパレータで、電解質を挟持する一対の電極を挟んだことを特徴とする燃料電池である。

【００２５】上記第６の技術的手段による効果は、以下のようである。

【００２６】すなわち、耐食性に優れた燃料電池用セパレータを使用しているため、電極反応で形成される腐食性物質などにより燃料電池用セパレータが腐食されないので、耐久性に優れた燃料電池ができる。

【００２７】

【発明の実施の形態】以下、本発明の実施例について説明する。

【００２８】図１は、本発明の実施例の固体高分子電解質型燃料電池セルの概略断面図である。電解質である固体高分子電解質膜１を挟持する一対の電極（酸化剤極２ａと燃料極２ｂ）は、それぞれの電極２ａ、２ｂの固体高分子電解質膜１と背向する一対のセパレータ３ａと３ｂの間に挟まれ、適切な圧力で加圧して固定し固体高分子電解質型燃料電池セル２０を形成する。

【００２９】酸素を含む酸化剤ガスは、水蒸気で加湿されて酸化剤ガス入口５より導入され、セパレータ３ａに形成された酸化剤ガス流路６を通流し、酸化剤ガス出口７から排出される。一方、水素を主成分とする燃料ガスは、水蒸気で加湿されて燃料ガス入口８から導入され、セパレータ３ｂに形成された燃料ガス流路９を通流し、燃料ガス出口２１から排出される。シール部材４は、固体高分子電解質膜１の周囲部に設けられ、前記酸化剤ガス及び前記燃料ガスをシールしている。

【００３０】固体高分子電解質型燃料電池セル２０は約８０℃に加熱され、前記燃料ガス中の水素と前記酸化剤ガス中の酸素を利用して電気化学反応により発電する。燃料ガス流路９の燃料ガス中の水素が燃料極２ｂの触媒に接触することにより下記の反応が生ずる。

【００３１】$2H_2 \rightarrow 4H^+ + 4e^-$

H^+ は、固体高分子電解質膜１中を移動し酸化剤極２ａの触媒に達し、前記酸化剤ガス流路６の酸化剤ガス中の酸素と反応して水となる。

【００３２】$4H^+ + 4e^- + O_2 \rightarrow 2H_2O$

上記の電極反応により起電力が生じ、セパレータ３ａ、３ｂにより外部に電流が取り出される。燃料電池は、一般的に前記固体高分子電解質型燃料電池セル２０が多数積層されて構成されている。この場合、単に図１の固体高分子電解質型燃料電池セル２０のまま積層するのではなく、効率的に積層できるような様々な積層形態が存在する。

【００３３】以後の本発明の効果を証明する実施例においては、セパレータ基材として板状のものを用いて行った。図２は本発明の実施例に用いた封孔処理前のセパレータの模式断面図である。セパレータ基材１０の電極に面する側の表面に、耐食性被膜として厚さ約０．１μｍの金メッキを施し、セパレータ３０を作製した。このメッキ層１１には微小なピンホール１２が存在する。

【００３４】（実施例１）図３は実施例１のセパレータの封孔工程を説明する説明図である。セパレータ基材１０の金属材料としてＳＵＳ３０４を使用した。

【００３５】セパレータ３０をイソプロピルアルコールにより洗浄後、真空容器１３中に入れ、真空容器１３を０．１Ｔｏｒｒ以下の真空にする。この後、脱泡処理したアクリルモノマー液を、真空容器１３に注入し、セパレータ３０をアクリルモノマー液２２に完全に浸す。真空容器１３に空気を導入し、ピンホール１２に完全にアクリルモノマー液を充満させる。

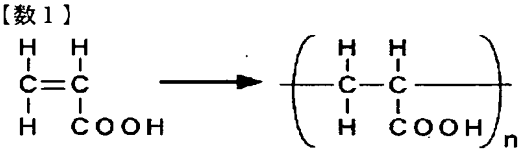
【００３６】セパレータ３０を真空容器１３から取り出すと、メッキ層１１の表面はアクリルモノマー液膜１４

に完全に覆われた状態になっている。このセパレータ３０を純水で軽く表面洗浄すると、メッキ層１１の表面のアクリルモノマー液膜１４が取り除かれ、ピンホール１２だけにアクリルモノマー封止液１８が残る。

【００３７】次に、このセパレータ３０を恒温槽に入れ８０℃、３時間の熱処理を行った。熱処理によりピンホール１２内のアクリルモノマーが下記の重合反応を起こしアクリルポリマー１９となりピンホール１２を封止する。

【００３８】

【数１】



【００３９】８０℃の水蒸気雰囲気中で水蒸気暴露試験を行い、耐食性を評価した。また電極基材であるカーボンペーパーとの接触抵抗を測定し、導電性を評価した。

【００４０】（比較例）実施例１の封孔処理前のセパレータ３０を比較例とし、実施例１と同じ方法で、耐食性、導電性を評価した。

【００４１】（評価結果）実施例１の耐食性試験結果では１０００時間までの評価で腐食は全く見られず安定した表面が確保されていた。一方、比較例は約５００時間で腐食が確認された。実施例１の封孔処理により、メッキ層１１に存在するピンホール１２が確実にアクリルポリマー１９で封孔されたため、腐食が発生しなかったものである。ピンホール１２は極めて微小であり、目視できないが、アクリルモノマー液２２に浸漬することにより確実に封孔処理できたものである。

【００４２】実施例１の接触抵抗は、２０ｍΩ・ｃｍ²であり、比較例と同じ値であった。１０００時間の耐食性試験後でも接触抵抗は、初期と同じ２０ｍΩ・ｃｍ²であった。セパレータ３０表面におけるピンホール１２の占める面積は極めて小さく、ピンホール１２以外の部分にアクリルポリマーが付着していないので、低い接触抵抗を維持できたものである。

【００４３】本実施例１では、セパレータ基材の金属材料としてＳＵＳ３０４を使用しているが、この金属に限定されずステンレスの他の品番でもよく、あるいはアルミニウムやチタンでもよい。耐食性被膜の材料として金を使用しているが、金以外に銀、窒化クロム、白金族の複合酸化物などが考えらる。耐食性被膜の形成方法としてメッキ法を使用しているが、メッキ以外にＣＶＤ、ＰＶＤなど他の被膜形成方法でも形成できる。また耐食性被膜とセパレータ基材の間には必要に応じて中間層を用いてもよい。

【００４４】本実施例１では、ピンホール１２を封孔する樹脂としてアクリルポリマーを使用しているが、この樹脂に限定されない。この封孔方法として真空含浸・加熱重合法を使用しているが、特にこの方法に限定されない。例えば、加熱重合法以外に紫外線重合法などを使用できる。

【００４５】（実施例２）図４は実施例２のセパレータの封孔工程を説明する説明図である。セパレータ基材の金属材料としてＳＵＳ３０４を使用した。

【００４６】セパレータ３０をイソプロピルアルコールにより洗浄後、ローラ１５を用いて線圧１ｔ／ｃｍ²、送り速度５０ｃｍ／ｍｉｎでローラプレス処理を行った。このローラプレス処理の結果、延性が大きく柔らかい金メッキ層１１が展伸し、ピンホール１２が押しつぶされて封孔部１６となった。

【００４７】この場合、封孔可能なピンホール１２の直径はメッキ層１１の厚さ以下のものである。したがって、発生するピンホールの最大直径より厚いメッキ層を設けておく必要がある。また、この封孔処理方法は、平板タイプのセパレータに適用される。燃料ガスまたは酸化剤ガスの流路は、カーボンペーパーなどの別体のガス流路板を組み合わせて構成される。

【００４８】耐食性および導電性の評価を実施例１と同じ方法で行った。この結果、実施例１と同様に１０００時間までの評価で腐食は全く見られず安定した表面が確保されていた。ローラープレスによりすべてのピンホールを封孔できたことを示している。ローラープレスによる封孔は、メッキ層自身で封孔するので、異種物質の界面ができず、安定で、大きな耐食性が期待できる。

【００４９】接触抵抗は、２０ｍΩ・ｃｍ²であり、比較例と同じ値であった。１０００時間の耐食性試験後でも接触抵抗は、初期と同じ２０ｍΩ・ｃｍ²であった。ピンホールの占める面積は極めて小さいので、比較例と同じ値となったが、この場合は比較例より接触抵抗が低くなる可能性がある。

【００５０】なお、実施例１と同様に、セパレータ基材の金属材料や耐食性被膜について実施例２に示したものに限定されない。ただし、実施例２の耐食性被膜の材料として延性を有する材料である必要がある。

【００５１】（実施例３）図５は実施例３のセパレータの封孔工程を説明する説明図である。セパレータ基材の金属材料としてアルミニウム５０５２を使用した。セパレータがアルミニウムの場合は、アルミニウムの表面にニッケルメッキ処理し、その上に金メッキ処理を行った。ピンホールは、ニッケルメッキの段階で生じており、その上の金メッキ層もニッケルメッキ層のピンホールがつながる形で生じている。このニッケルメッキ層は図示されていない。

【００５２】イソプロピルアルコールにより洗浄後、セパレータ３０を電解液２３（１５％硫酸溶液）に浸漬した。次に、電解液２３の温度を２０℃にし、１．５Ａ／ｃｍ２の電流密度で１５秒間陽極酸化した。この陽極酸

化処理により、ピンホール１２で電解液に露出しているアルミニウムが陽極酸化され、この部分に酸化アルミニウムが形成された。この酸化アルミニウムが不動態の酸化被膜１７となっている。

【００５３】耐食性および導電性の評価を実施例１と同じ方法で行った。この結果、実施例１と同様に１０００時間までの評価で腐食は全く見られず安定した表面が確保されていた。ピンホールが確実に酸化被膜１７で封孔されたため、腐食が発生しなかったものである。ピンホールは極めて微小であり、目視できないが、電気的に処理する陽極酸化により確実に封孔処理できたものである。

【００５４】接触抵抗は、２０mΩ・cm² であり、比較例と同じ値であった。１０００時間の耐食性試験後でも接触抵抗は、初期と同じ２０mΩ・cm² であった。ピンホールの占める面積は極めて小さく、ピンホール以外の部分には酸化被膜は付かないので、低い接触抵抗を維持できたものである。

【００５５】なお、実施例１と同様に、セパレータ基材の金属材料や耐食性被膜について実施例３に示したものに限定されない。また、酸化処理の方法も実施例３に示したものに限定されず、高温による熱酸化法などでもよい。

【００５６】

【発明の効果】以上のように、本発明は、電解質を挟持する一対の電極の該電解質と背向する一対の金属製の燃料電池用セパレータにおいて、少なくとも一部の表面に耐食性被膜が形成され、該耐食性被膜に形成されたピンホールが封孔処理されていることを特徴とする燃料電池用セパレータ及び金属材料から燃料電池用セパレータ基材形状を形成する形状加工工程と、該燃料電池用セパレータ基材の少なくとも一部の表面に耐食性被膜を形成す＊

＊る被覆工程と、該耐食性被膜に形成されたピンホールを封孔処理する封孔工程からなることを特徴とする燃料電池用セパレータの製造方法およびこの一対の燃料電池用セパレータで、電解質を挟持する一対の電極を挟んだことを特徴とする燃料電池であるので、耐食性に優れた燃料電池用セパレータおよびおよび耐久性に優れた燃料電池ができる。

【図面の簡単な説明】

【図１】本発明の実施例の固体高分子電解質型燃料電池セルの概略断面図

【図２】本発明の実施例に用いた封孔処理前のセパレータの模式断面図

【図３】実施例１のセパレータの封孔工程を説明する説明図

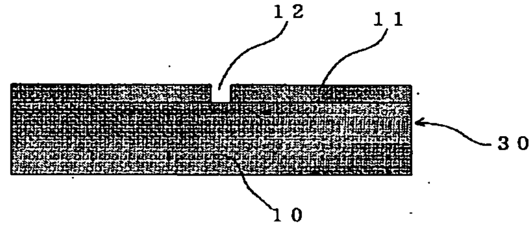
【図４】実施例２のセパレータの封孔工程を説明する説明図

【図５】実施例３のセパレータの封孔工程を説明する説明図

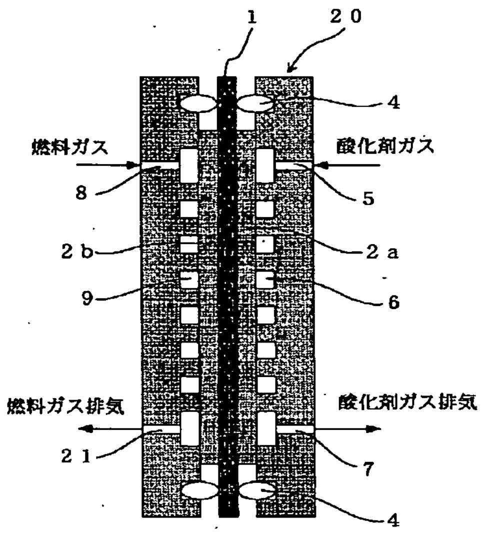
【符号の説明】

１…固体高分子電解質膜（電解質）
２ａ…酸化剤極（電極）
２ｂ…燃料極（電極）
３ａ、３ｂ、３０…セパレータ
１０…セパレータ基材
１１…金メッキ層（耐食性被覆膜）
１２…ピンホール
１５…ローラ
１６…封孔部
１７…酸化被膜
１８…アクリルポリマー（樹脂）
２０…固体高分子電解質型燃料電池セル（燃料電池）

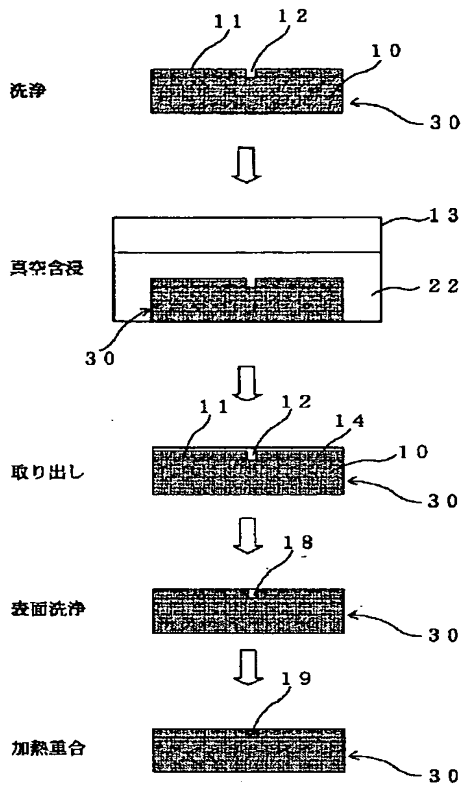
【図２】



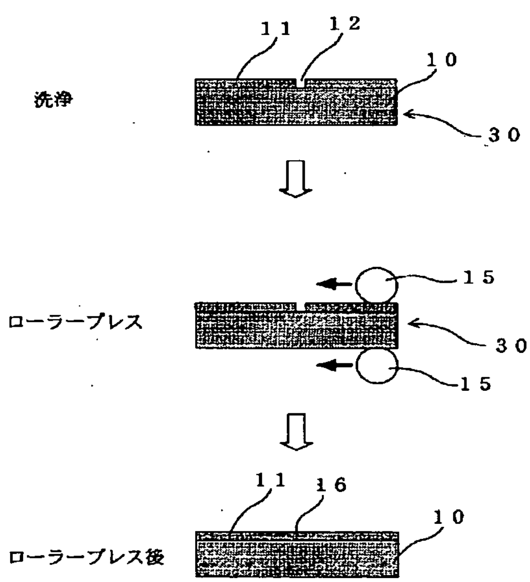
【図１】


燃料ガス
酸化剤ガス
燃料ガス排気
酸化剤ガス排気

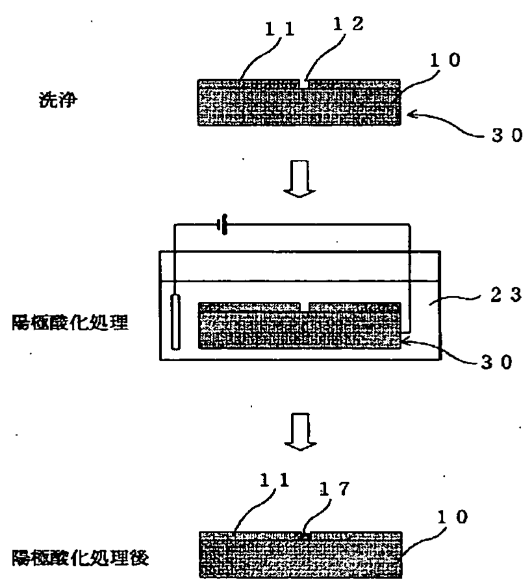
【図３】


洗浄
真空含浸
取り出し
表面洗浄
加熱重合

【図４】


洗浄
ローラープレス
ローラープレス後

【図５】


洗浄
陽極酸化処理
陽極酸化処理後

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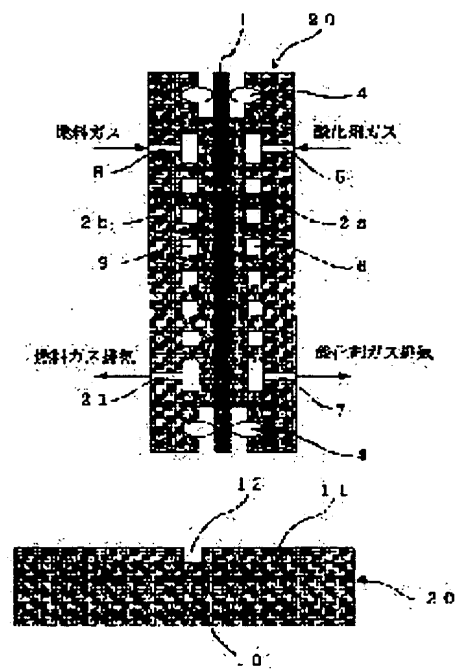
(54) SEPARATOR FOR FUEL CELL, MANUFACTURE THEREOF AND FUEL CELL

(57)Abstract:
PROBLEM TO BE SOLVED: To improve corrosion resistance of a separator for a fuel cell and enhance durability of the fuel cell.
SOLUTION: At least part of the surface of each of a pair of metallic separators 30 for a fuel cell disposed back to back in an electrolyte 1 held between a pair of electrodes 2a, 2b is coated with a corrosion resistant coating film 11. A pin hole 12 formed in the corrosion resistant coating film 11 is sealed. In a fuel cell 20, the pair of electrodes 2a, 2b holding the electrolyte 1 therebetween are sandwiched between the pair of separators 30.



LEGAL STATUS
[Date of request for examination]
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[Kind of final disposal of application other than the examiner's decision of rejection or application converted registration]
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[Patent number]
[Date of registration]
[Number of appeal against examiner's decision of rejection]
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[Date of extinction of right]

CLAIMS

[Claim(s)]
[Claim 1] The separator for fuel cells characterized by carrying out sealing of the pinhole which the corrosion-resistant coat was formed in some [at least] front faces, and was formed in this corrosion-resistant coat in the metal separator for fuel cells of this electrolyte of the electrode of the pair which pinches an electrolyte, and the pair facing in opposite directions.
[Claim 2] The manufacture approach of the separator for fuel cells characterized by consisting of the configuration processing process which forms the separator base material configuration for fuel cells from a metallic material, a covering process which forms a corrosion-resistant coat in some [at least] front faces of this separator base material for fuel cells, and a sealing process which carries out sealing of the pinhole formed in this corrosion-resistant coat.
[Claim 3] The manufacture approach of the separator for fuel cells according to claim 2 characterized by said sealing process being a process which closes said pinhole by resin.
[Claim 4] The manufacture approach of the separator for fuel cells according to claim 2 characterized by being the process at which said corrosion-resistant coat is formed in from the ingredient which has ductility, and said sealing process crushes a pinhole for said corrosion-resistant coat by roller pressurization.
[Claim 5] The manufacture approach of the separator for fuel cells according to claim 2 which said sealing process oxidizes said separator base material for fuel cells, forms an oxide skin, and is characterized by being a wrap process in an oxide skin about the separator base material of a pinhole.
[Claim 6] The fuel cell characterized by inserting the electrode of the pair which pinches an electrolyte with the separator for fuel cells of a pair according to claim 1 to 5.

[Translation done.]

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention] This invention relates to the separator for fuel cells, its manufacture approach, and a fuel cell.
[0002]
[Description of the Prior Art] Although the cure against exhaust gas of an automobile is important and the electric vehicle is used as one of the cure of the in order to reduce atmospheric contamination as much as possible, it has not resulted in spread on problems, such as a charging equipment and mileage.
[0003] It is concluded that the automobile which a fuel cell is generated by the reverse reaction of electrolysis using hydrogen and oxygen, does not have excretions other than water, is observed as a clean power plant, and used said fuel cell is most promising clean automobile. In order that a solid-state polyelectrolyte mold fuel cell may operate at low temperature also in said fuel cell, it is the most promising as an object for automobiles.
[0004] Generally as for said solid-state polyelectrolyte mold fuel cell, the laminating of many cels is carried out, and this cel is having structure which sandwiched the zygote of the solid-state polyelectrolyte film joined on both sides of the solid-state polyelectrolyte film with two electrodes (a fuel electrode and oxidizer pole), and an electrode with the separator which has the gas passageway of fuel gas or oxidizer gas.
[0005] There is a problem of having been a failure when said fuel cell spreads widely that cost is [one] high, and it is important to lower the cost of the electrode which is the main component part of a fuel cell as much as possible. Moreover, small and lightweight-ization are called for as objects for mount, such as an automobile. Researches and developments of utilization of a metal separator are furthered instead of the conventional compactness carbon separator for low-cost-izing, and small and lightweight-izing.
[0006] As engine performance required of this metal separator, contact resistance with an electrode may be excellent in a low thing and corrosion resistance. In order to realize this engine performance, the metal bipolar plate which carried out plating processing is indicated by JP,6-349508,A as a conventional technique.
[0007]
[Problem(s) to be Solved by the Invention] However, even if it performs plating processing to a surface of metal like the conventional technique, it is unescapable that a minute pinhole is generated, the corrosion of a metal base arose from this pinhole section, and the problem was in corrosion resistance.
[0008] This invention is what solved the above-mentioned technical problem, and offers the fuel cell excellent in the separator for fuel cells excellent in corrosion resistance, its manufacture approach, and endurance.
[0009]
[Means for Solving the Problem] In order to solve the above-mentioned technical technical problem, the technical means (the 1st technical means are called hereafter.) provided in claim 1 of this invention are separators for fuel cells characterized by carrying out sealing of the pinhole

which the corrosion-resistant coat was formed in some [at least] front faces, and was formed in this corrosion-resistant coat in the metal separator for fuel cells of this electrolyte of the electrode of the pair which pinches an electrolyte, and the pair facing in opposite directions.
[0010] The effectiveness by the 1st technical means of the above is as follows.
[0011] That is, since sealing can close a pinhole, the separator for fuel cells which the separator base material for fuel cells is not corroded from this pinhole, and was excellent in corrosion resistance can be done.
[0012] In order to solve the above-mentioned technical technical problem, the technical means (the 2nd technical means are called hereafter.) provided in claim 2 of this invention The configuration processing process which forms the separator base material configuration for fuel cells from a metallic material, It is the manufacture approach of the separator for fuel cells characterized by consisting of a covering process which forms a corrosion-resistant coat in some [at least] front faces of this separator base material for fuel cells, and a sealing process which carries out sealing of the pinhole formed in this corrosion-resistant coat.
[0013] The effectiveness by the 2nd technical means of the above is as follows.
[0014] That is, since a sealing process can close a pinhole, the separator for fuel cells which the separator base material for fuel cells is not corroded from this pinhole, and was excellent in corrosion resistance can be done.
[0015] In order to solve the above-mentioned technical technical problem, the technical means (the 3rd technical means are called hereafter.) provided in claim 3 of this invention are the manufacture approaches of the separator for fuel cells according to claim 2 characterized by said sealing process being a process which closes said pinhole by resin.
[0016] The effectiveness by the 3rd technical means of the above is as follows.
[0017] That is, since cheap resin can close a pinhole, the separator for fuel cells of low cost can be done.
[0018] in order to solve the above-mentioned technical technical problem , the technical means (the 4th technical means be call hereafter .) provided in claim 4 of this invention be the manufacture approaches of the separator for fuel cells according to claim 2 characterize by be the process at which said corrosion-resistant coat be form in from the ingredient which have ductility , and said sealing process crush a pinhole for said corrosion-resistant coat by roller pressurization .
[0019] The effectiveness by the 4th technical means of the above is as follows.
[0020] That is, since a pinhole can be taken up for corrosion-resistant coat itself, the separator for fuel cells of low cost can be done.
[0021] In order to solve the above-mentioned technical technical problem, it is the manufacture approach of the separator for fuel cells according to claim 2 that the technical means (the 5th technical means are called hereafter.) provided in claim 5 of this invention are characterized by for said sealing process oxidizing said separator base material for fuel cells, forming an oxide skin, and being a wrap process in an oxide skin about the separator base material of a pinhole.
[0022] The effectiveness by the 5th technical means of the above is as follows.
[0023] That is, since the oxide skin which oxidized the separator base material for fuel cells can close a pinhole, a pinhole can be taken up certainly and the separator for fuel cells excellent in corrosion resistance can be done.
[0024] In order to solve the above-mentioned technical technical problem, the technical means (the 6th technical means are called hereafter.) provided in claim 6 of this invention are the separators for fuel cells of a pair according to claim 1 to 5, and are fuel cells characterized by inserting the electrode of the pair which pinches an electrolyte.
[0025] The effectiveness by the 6th technical means of the above is as follows.
[0026] That is, since the separator for fuel cells excellent in corrosion resistance is used and the separator for fuel cells is not corroded by the staining substance formed by electrode reaction, the fuel cell excellent in endurance can be done.
[0027]
[Embodiment of the Invention] Hereafter, the example of this invention is explained.
[0028] Drawing 1 is the outline sectional view of the solid-state polyelectrolyte mold fuel cell cel

of the example of this invention. It is inserted between each electrode 2a, the solid-state polyelectrolyte film 1 of 2b, and the separators 3a and 3b of the pair facing in opposite directions, and pressurizes and fixes by the suitable pressure, and the electrode (oxidizer pole 2a and fuel electrode 2b) of the pair which pinches the solid-state polyelectrolyte film 1 which is an electrolyte forms the solid-state polyelectrolyte mold fuel cell cel 20.

[0029] The oxidizer gas containing oxygen is humidified with a steam, is introduced from the oxidizer gas inlet 5, carries out conduction of the oxidizer gas passageway 6 formed in separator 3a, and is discharged from the oxidizer gas outlet 7. On the other hand, the fuel gas which uses hydrogen as a principal component is humidified with a steam, is introduced from the fuel gas inlet port 8, carries out conduction of the fuel gas passage 9 formed in separator 3b, and is discharged from the fuel gas outlet 21. The seal member 4 is formed in the perimeter section of the solid-state polyelectrolyte film 1, and is carrying out the seal of said oxidizer gas and said fuel gas.

[0030] The solid-state polyelectrolyte mold fuel cell cel 20 is heated by about 80 degrees C, and is generated according to electrochemical reaction using the hydrogen in said fuel gas, and the oxygen in said oxidizer gas. When the hydrogen in the fuel gas of the fuel gas passage 9 contacts the catalyst of fuel electrode 2b, the following reaction arises.

[0031] 2H2 -> 4H+ +4 e-H+ moves in the inside of the solid-state polyelectrolyte film 1, reaches the catalyst of oxidizer pole 2a, reacts with the oxygen in the oxidizer gas of said oxidizer gas passageway 6, and becomes water.

[0032] 4H+ +4e- +O2 -> Electromotive force arises according to the electrode reaction of the 2H2O above, and a current is taken out outside with Separators 3a and 3b. Generally, the laminating of a majority of said solid-state polyelectrolyte mold fuel cell cels 20 is carried out, and the fuel cell is constituted. In this case, a laminating is not carried out only with the solid-state polyelectrolyte mold fuel cell cel 20 of drawing 1 , but various laminating gestalten which can carry out a laminating efficiently exist.

[0033] In the example proving the effectiveness of future this inventions, it carried out using the tabular thing as a separator base material. Drawing 2 is the type section Fig. of the separator before sealing used for the example of this invention. To the near front face facing the electrode of the separator base material 10, gold plate with a thickness of about 0.1 micrometers was performed as a corrosion-resistant coat, and the separator 30 was produced on it. The minute pinhole 12 exists in this deposit 11.

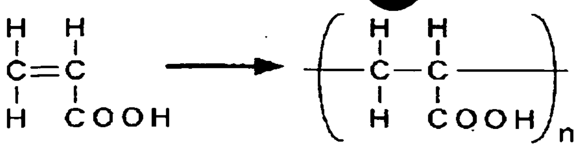
[0034] (Example 1) Drawing 3 is an explanatory view explaining the sealing process of the separator of an example 1. SUS304 was used as a metallic material of the separator base material 10.

[0035] A separator 30 is put in after washing and into a vacuum housing 13 by isopropyl alcohol, and a vacuum housing 13 is made into the vacuum of 0.1 or less Torrs. Then, the acrylic monomer liquid which carried out degassing processing is poured into a vacuum housing 13, and a separator 30 is completely dipped in acrylic monomer liquid 22. Air is introduced into a vacuum housing 13 and a pinhole 12 is completely made full of acrylic monomer liquid.

[0036] If a separator 30 is taken out from a vacuum housing 13, it will be completely covered with the acrylic monomer liquid membrane 14 by the front face of a deposit 11. If surface washing of this separator 30 is lightly carried out with pure water, the acrylic monomer liquid membrane 14 of the front face of a deposit 11 will be removed, and acrylic monomer sealing liquid 18 will remain only in a pinhole 12.

[0037] Next, this separator 30 was put into the thermostat and 80 degrees C and heat treatment of 3 hours were performed. The acrylic monomer in a pinhole 12 serves as the lifting acrylic polymer 19 in the following polymerization reaction by heat treatment, and a pinhole 12 is closed.

[0038]
[Equation 1]



[0039] The steam exposure test was performed in the 80-degree C steam ambient atmosphere, and corrosion resistance was evaluated. Moreover, contact resistance with the carbon paper which is an electrode substrate was measured, and conductivity was evaluated.
[0040] (Example of a comparison) The separator 30 before sealing of an example 1 was made into the example of a comparison, and the same approach as an example 1 estimated corrosion resistance and conductivity.
[0041] (Evaluation result) By the corrosion resistance test result of an example 1, the front face which corrosion was not seen at all but was stabilized was secured by the evaluation by 1000 hours. On the other hand, as for the example of a comparison, corrosion was checked in about 500 hours. Since sealing of the pinhole 12 which exists in a deposit 11 was certainly carried out by the acrylic polymer 19 by sealing of an example 1, corrosion does not occur. Although the pinhole 12 is very minute and it cannot view, sealing can be certainly carried out by being immersed in acrylic monomer liquid 22.
[0042] The contact resistance of an example 1 was 20m ohm-cm 2, and was the same value as the example of a comparison. Contact resistance was the same 20m ohm-cm 2 as the first stage also after the corrosion resistance test of 1000 hours. The area which the pinhole 12 in separator 30 front face occupies is very small, and since the acrylic polymer has not adhered to any parts other than pinhole 12, low contact resistance is maintainable.
[0043] In this example 1, although SUS304 is used as a metallic material of a separator base material, it may not be limited to this metal, other stainless lot numbers are sufficient, or aluminum and titanium are sufficient. Although gold is used as an ingredient of a corrosion-resistant coat, silver, nitriding chromium, the multiple oxide of a platinum group, etc. are idea ** in addition to gold. Although plating is used as the formation approach of a corrosion-resistant coat, CVD, PVD, etc. can be formed by other coat formation approaches in addition to plating. Moreover, between a corrosion-resistant coat and a separator base material, an interlayer may be used if needed.
[0044] Although the acrylic polymer is used in this example 1 as resin which seals a pinhole 12, it is not limited to this resin. Although vacuum impregnation and a heating polymerization method are used as this sealing approach, it is not limited to especially this approach. For example, an ultraviolet-rays polymerization method etc. can be used in addition to a heating polymerization method.
[0045] (Example 2) Drawing 4 is an explanatory view explaining the sealing process of the separator of an example 2. SUS304 was used as a metallic material of a separator base material.
[0046] Isopropyl alcohol performed roller-press processing for the separator 30 by 2 and feed-rate 50 cm/min the linear pressure of 1t/cm after washing using the roller 15. As a result of this roller-press processing, the gold plate layer 11 with it carried out expansion, the pinhole 12 was crushed, and it became the sealing section 16. [large ductility and] [soft]
[0047] In this case, the diameter of the pinhole 12 which can seal is as follows [the thickness of a deposit 11]. Therefore, it is necessary to prepare a deposit thicker than the diameter at the maximum equator of the pinhole to generate. Moreover, this sealing approach is applied to a monotonous type separator. The passage of fuel gas or oxidizing agent gas is constituted combining the gas-passageway plate of another objects, such as carbon paper.
[0048] Corrosion resistance and conductive evaluation was performed by the same approach as an example 1. Consequently, the front face which corrosion was not seen at all but was stabilized was secured by the evaluation by 1000 hours like the example 1. It is shown that all the pinholes have been sealed with the roller press. Since sealing by the roller press is sealed for deposit itself, it cannot do the interface of dissimilar material but can expect stable and big corrosion resistance.
[0049] Contact resistance was 20m ohm-cm 2, and was the same value as the example of a

comparison. Contact resistance was the same 20m ohm-cm 2 as the first stage also after the corrosion resistance test of 1000 hours. Although it became the same value as the example of a comparison since the area which a pinhole occupies was very small, contact resistance may become low from the example of a comparison in this case.
[0050] In addition, it is not limited to what was shown in the example 2 about the metallic material and the corrosion-resistant coat of a separator base material like an example 1. However, it is necessary to be the ingredient which has ductility as an ingredient of the corrosion-resistant coat of an example 2.
[0051] (Example 3) Drawing 5 is an explanatory view explaining the sealing process of the separator of an example 3. Aluminum 5052 was used as a metallic material of a separator base material. When a separator was aluminum, nickel-plating processing was carried out on the surface of aluminum, and gold plate processing was performed on it. It is generated in the phase of nickel plating and the pinhole has also produced the gold plate layer on it in the form where the pinhole of a nickel-plating layer is connected. This nickel-plating layer is not illustrated.
[0052] The separator 30 was immersed in the electrolytic solution 23 (15% sulfuric-acid solution) after washing by isopropyl alcohol. Next, temperature of the electrolytic solution 23 was made into 20 degrees C, and it anodized for 15 seconds with the current density of 1.5 A/cm2. The aluminum exposed to the electrolytic solution at the pinhole 12 was anodized by this anodizing, and the aluminum oxide was formed in this part of it. This aluminum oxide serves as the oxide skin 17 of a passive state.
[0053] Corrosion resistance and conductive evaluation was performed by the same approach as an example 1. Consequently, the front face which corrosion was not seen at all but was stabilized was secured by the evaluation by 1000 hours like the example 1. Since sealing of the pinhole was certainly carried out by the oxide skin 17, corrosion does not occur. Although the pinhole is very minute and it cannot view, sealing can be certainly carried out by anodic oxidation processed electrically.
[0054] Contact resistance was 20m ohm-cm 2, and was the same value as the example of a comparison. Contact resistance was the same 20m ohm-cm 2 as the first stage also after the corrosion resistance test of 1000 hours. The area which a pinhole occupies is very small, and since an oxide skin is not attached to any parts other than a pinhole, low contact resistance is maintainable.
[0055] In addition, it is not limited to what was shown in the example 3 about the metallic material and the corrosion-resistant coat of a separator base material like an example 1. Moreover, it may not be limited to what also showed the approach of oxidation treatment to the example 3, but the oxidizing [thermally] method by the elevated temperature etc. may be used.
[0056]
[Effect of the Invention] As mentioned above, this invention is set to the metal separator for fuel cells of this electrolyte of the electrode of the pair which pinches an electrolyte, and the pair facing in opposite directions. The configuration processing process which forms the separator base material configuration for fuel cells from the separator for fuel cells characterized by carrying out sealing of the pinhole which the corrosion-resistant coat was formed in some [at least] front faces, and was formed in this corrosion-resistant coat, and a metallic material, The covering process which forms a corrosion-resistant coat in some [at least] front faces of this separator base material for fuel cells, With the manufacture approach of the separator for fuel cells characterized by consisting of a sealing process which carries out sealing of the pinhole formed in this corrosion-resistant coat, and the separator for fuel cells of this pair Since it is the fuel cell characterized by inserting the electrode of the pair which pinches an electrolyte, the separator for fuel cells excellent in corrosion resistance and the fuel cell which reached and was excellent in endurance can be done.

[Translation done.]

TECHNICAL FIELD

[Field of the Invention] This invention relates to the separator for fuel cells, its manufacture approach, and a fuel cell.

[Translation done.]

PRIOR ART

[Description of the Prior Art] Although the cure against exhaust gas of an automobile is important and the electric vehicle is used as one of the cure of the in order to reduce atmospheric contamination as much as possible, it has not resulted in spread on problems, such as a charging equipment and mileage.
[0003] It is concluded that the automobile which a fuel cell is generated by the reverse reaction of electrolysis using hydrogen and oxygen, does not have excretions other than water, is observed as a clean power plant, and used said fuel cell is most promising clean automobile. In order that a solid-state polyelectrolyte mold fuel cell may operate at low temperature also in said fuel cell, it is the most promising as an object for automobiles.
[0004] Generally as for said solid-state polyelectrolyte mold fuel cell, the laminating of many cels is carried out, and this cel is having structure which sandwiched the zygote of the solid-state polyelectrolyte film joined on both sides of the solid-state polyelectrolyte film with two electrodes (a fuel electrode and oxidizer pole), and an electrode with the separator which has the gas passageway of fuel gas or oxidizer gas.
[0005] There is a problem of having been a failure when said fuel cell spreads widely that cost is [one] high, and it is important to lower the cost of the electrode which is the main component part of a fuel cell as much as possible. Moreover, small and lightweight-ization are called for as objects for mount, such as an automobile. Researches and developments of utilization of a metal separator are furthered instead of the conventional compactness carbon separator for low-cost-izing, and small and lightweight-izing.
[0006] As engine performance required of this metal separator, contact resistance with an electrode may be excellent in a low thing and corrosion resistance. In order to realize this engine performance, the metal bipolar plate which carried out plating processing is indicated by JP,6-349508,A as a conventional technique.

[Translation done.]

EFFECT OF THE INVENTION

[Effect of the Invention] As mentioned above, in this invention, it sets to this electrolyte of the electrode of the pair which pinches an electrolyte, and the metal separator for fuel cells of the pair facing in opposite directions. The configuration processing process which forms the separator base material configuration for fuel cells from the separator for fuel cells characterized by carrying out sealing of the pinhole which the corrosion-resistant coat was formed in some [at least] front faces, and was formed in this corrosion-resistant coat, and a metallic material, The covering process which forms a corrosion-resistant coat in some [at least] front faces of this separator base material for fuel cells, It is the manufacture approach of the separator for fuel cells characterized by consisting of a sealing process which carries out sealing of the pinhole formed in this corrosion-resistant coat, and the separator for fuel cells of this pair, and is the fuel cell characterized by inserting the electrode of the pair which pinches an electrolyte. Therefore, the separator for fuel cells excellent in corrosion resistance and the fuel cell which reached and was excellent in endurance can be done.

[Translation done.]

TECHNICAL PROBLEM

[Problem(s) to be Solved by the Invention] However, even if it performs plating processing to a surface of metal like the conventional technique, it is unescapable that a minute pinhole is generated, the corrosion of a metal base arose from this pinhole section, and the problem was in corrosion resistance.
[0008] This invention is what solved the above-mentioned technical problem, and offers the fuel cell excellent in the separator for fuel cells excellent in corrosion resistance, its manufacture approach, and endurance.

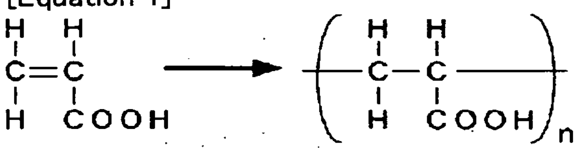
[Translation done.]

MEANS

[Means for Solving the Problem] In order to solve the above-mentioned technical technical problem, the technical means (the 1st technical means are called hereafter.) provided in claim 1 of this invention are separators for fuel cells characterized by carrying out sealing of the pinhole which the corrosion-resistant coat was formed in some [at least] front faces, and was formed in this corrosion-resistant coat in the metal separator for fuel cells of this electrolyte of the electrode of the pair which pinches an electrolyte, and the pair facing in opposite directions.
[0010] The effectiveness by the 1st technical means of the above is as follows.
[0011] That is, since sealing can close a pinhole, the separator for fuel cells which the separator base material for fuel cells is not corroded from this pinhole, and was excellent in corrosion resistance can be done.
[0012] In order to solve the above-mentioned technical technical problem, the technical means (the 2nd technical means are called hereafter.) provided in claim 2 of this invention The configuration processing process which forms the separator base material configuration for fuel cells from a metallic material, It is the manufacture approach of the separator for fuel cells characterized by consisting of a covering process which forms a corrosion-resistant coat in some [at least] front faces of this separator base material for fuel cells, and a sealing process which carries out sealing of the pinhole formed in this corrosion-resistant coat.
[0013] The effectiveness by the 2nd technical means of the above is as follows.
[0014] That is, since a sealing process can close a pinhole, the separator for fuel cells which the separator base material for fuel cells is not corroded from this pinhole, and was excellent in corrosion resistance can be done.
[0015] In order to solve the above-mentioned technical technical problem, the technical means (the 3rd technical means are called hereafter.) provided in claim 3 of this invention are the manufacture approaches of the separator for fuel cells according to claim 2 characterized by said sealing process being a process which closes said pinhole by resin.
[0016] The effectiveness by the 3rd technical means of the above is as follows.
[0017] That is, since cheap resin can close a pinhole, the separator for fuel cells of low cost can be done.
[0018] in order to solve the above-mentioned technical technical problem , the technical means (the 4th technical means be call hereafter .) provided in claim 4 of this invention be the manufacture approaches of the separator for fuel cells according to claim 2 characterize by be the process at which said corrosion-resistant coat be form in from the ingredient which have ductility , and said sealing process crush a pinhole for said corrosion-resistant coat by roller pressurization .
[0019] The effectiveness by the 4th technical means of the above is as follows.
[0020] That is, since a pinhole can be taken up for corrosion-resistant coat itself, the separator for fuel cells of low cost can be done.
[0021] In order to solve the above-mentioned technical technical problem, it is the manufacture approach of the separator for fuel cells according to claim 2 that the technical means (the 5th technical means are called hereafter.) provided in claim 5 of this invention are characterized by for said sealing process oxidizing said separator base material for fuel cells, forming an oxide

skin, and being a wrap process in an oxide skin about the separator base material of a pinhole.
[0022] The effectiveness by the 5th technical means of the above is as follows.
[0023] That is, since the oxide skin which oxidized the separator base material for fuel cells can close a pinhole, a pinhole can be taken up certainly and the separator for fuel cells excellent in corrosion resistance can be done.
[0024] In order to solve the above-mentioned technical technical problem, the technical means (the 6th technical means are called hereafter.) provided in claim 6 of this invention are the separators for fuel cells of a pair according to claim 1 to 5, and are fuel cells characterized by inserting the electrode of the pair which pinches an electrolyte.
[0025] The effectiveness by the 6th technical means of the above is as follows.
[0026] That is, since the separator for fuel cells excellent in corrosion resistance is used and the separator for fuel cells is not corroded by the staining substance formed by electrode reaction, the fuel cell excellent in endurance can be done.
[0027]
[Embodiment of the Invention] Hereafter, the example of this invention is explained.
[0028] Drawing 1 is the outline sectional view of the solid-state polyelectrolyte mold fuel cell cel of the example of this invention. It is inserted between each electrode 2a, the solid-state polyelectrolyte film 1 of 2b, and the separators 3a and 3b of the pair facing in opposite directions, and pressurizes and fixes by the suitable pressure, and the electrode (oxidizer pole 2a and fuel electrode 2b) of the pair which pinches the solid-state polyelectrolyte film 1 which is an electrolyte forms the solid-state polyelectrolyte mold fuel cell cel 20.
[0029] The oxidizer gas containing oxygen is humidified with a steam, is introduced from the oxidizer gas inlet 5, carries out conduction of the oxidizer gas passageway 6 formed in separator 3a, and is discharged from the oxidizer gas outlet 7. On the other hand, the fuel gas which uses hydrogen as a principal component is humidified with a steam, is introduced from the fuel gas inlet port 8, carries out conduction of the fuel gas passage 9 formed in separator 3b, and is discharged from the fuel gas outlet 21. The seal member 4 is formed in the perimeter section of the solid-state polyelectrolyte film 1, and is carrying out the seal of said oxidizer gas and said fuel gas.
[0030] The solid-state polyelectrolyte mold fuel cell cel 20 is heated by about 80 degrees C, and is generated according to electrochemical reaction using the hydrogen in said fuel gas, and the oxygen in said oxidizer gas. When the hydrogen in the fuel gas of the fuel gas passage 9 contacts the catalyst of fuel electrode 2b, the following reaction arises.
[0031] 2H2 -> 4H+ +4 e-H+ moves in the inside of the solid-state polyelectrolyte film 1, reaches the catalyst of oxidizer pole 2a, reacts with the oxygen in the oxidizer gas of said oxidizer gas passageway 6, and becomes water.
[0032] 4H+ +4e- +O2 -> Electromotive force arises according to the electrode reaction of the 2H2O above, and a current is taken out outside with Separators 3a and 3b. Generally, the laminating of a majority of said solid-state polyelectrolyte mold fuel cell cels 20 is carried out, and the fuel cell is constituted. In this case, a laminating is not carried out only with the solid-state polyelectrolyte mold fuel cell cel 20 of drawing 1 , but various laminating gestalten which can carry out a laminating efficiently exist.
[0033] In the example proving the effectiveness of future this inventions, it carried out using the tabular thing as a separator base material. Drawing 2 is the type section Fig. of the separator before sealing used for the example of this invention. To the near front face facing the electrode of the separator base material 10, gold plate with a thickness of about 0.1 micrometers was performed as a corrosion-resistant coat, and the separator 30 was produced on it. The minute pinhole 12 exists in this deposit 11.
[0034] (Example 1) Drawing 3 is an explanatory view explaining the sealing process of the separator of an example 1. SUS304 was used as a metallic material of the separator base material 10.
[0035] A separator 30 is put in after washing and into a vacuum housing 13 by isopropyl alcohol, and a vacuum housing 13 is made into the vacuum of 0.1 or less Torrs. Then, the acrylic monomer liquid which carried out degassing processing is poured into a vacuum housing 13, and

a separator 30 is completely dipped in acrylic monomer liquid 22. Air is introduced into a vacuum housing 13 and a pinhole 12 is completely made full of acrylic monomer liquid.
[0036] If a separator 30 is taken out from a vacuum housing 13, it will be completely covered with the acrylic monomer liquid membrane 14 by the front face of a deposit 11. If surface washing of this separator 30 is lightly carried out with pure water, the acrylic monomer liquid membrane 14 of the front face of a deposit 11 will be removed, and acrylic monomer sealing liquid 18 will remain only in a pinhole 12.
[0037] Next, this separator 30 was put into the thermostat and 80 degrees C and heat treatment of 3 hours were performed. The acrylic monomer in a pinhole 12 serves as the lifting acrylic polymer 19 in the following polymerization reaction by heat treatment, and a pinhole 12 is closed.

[0038]
[Equation 1]


[0039] The steam exposure test was performed in the 80-degree C steam ambient atmosphere, and corrosion resistance was evaluated. Moreover, contact resistance with the carbon paper which is an electrode substrate was measured, and conductivity was evaluated.
[0040] (Example of a comparison) The separator 30 before sealing of an example 1 was made into the example of a comparison, and the same approach as an example 1 estimated corrosion resistance and conductivity.
[0041] (Evaluation result) By the corrosion resistance test result of an example 1, the front face which corrosion was not seen at all but was stabilized was secured by the evaluation by 1000 hours. On the other hand, as for the example of a comparison, corrosion was checked in about 500 hours. Since sealing of the pinhole 12 which exists in a deposit 11 was certainly carried out by the acrylic polymer 19 by sealing of an example 1, corrosion does not occur. Although the pinhole 12 is very minute and it cannot view, sealing can be certainly carried out by being immersed in acrylic monomer liquid 22.
[0042] The contact resistance of an example 1 was 20m ohm-cm 2, and was the same value as the example of a comparison. Contact resistance was the same 20m ohm-cm 2 as the first stage also after the corrosion resistance test of 1000 hours. The area which the pinhole 12 in separator 30 front face occupies is very small, and since the acrylic polymer has not adhered to any parts other than pinhole 12, low contact resistance is maintainable.
[0043] In this example 1, although SUS304 is used as a metallic material of a separator base material, it may not be limited to this metal, other stainless lot numbers are sufficient, or aluminum and titanium are sufficient. Although gold is used as an ingredient of a corrosion-resistant coat, silver, nitriding chromium, the multiple oxide of a platinum group, etc. are idea ** in addition to gold. Although plating is used as the formation approach of a corrosion-resistant coat, CVD, PVD, etc. can be formed by other coat formation approaches in addition to plating. Moreover, between a corrosion-resistant coat and a separator base material, an interlayer may be used if needed.
[0044] Although the acrylic polymer is used in this example 1 as resin which seals a pinhole 12, it is not limited to this resin. Although vacuum impregnation and a heating polymerization method are used as this sealing approach, it is not limited to especially this approach. For example, an ultraviolet-rays polymerization method etc. can be used in addition to a heating polymerization method.
[0045] (Example 2) Drawing 4 is an explanatory view explaining the sealing process of the separator of an example 2. SUS304 was used as a metallic material of a separator base material.
[0046] Isopropyl alcohol performed roller-press processing for the separator 30 by 2 and feed-rate 50 cm/min the linear pressure of 1t/cm after washing using the roller 15. As a result of this roller-press processing, the gold plate layer 11 with it carried out expansion, the pinhole 12 was

crushed, and it became the sealing section 16. [large ductility and] [soft]
[0047] In this case, the diameter of the pinhole 12 which can seal is as follows [the thickness of a deposit 11]. Therefore, it is necessary to prepare a deposit thicker than the diameter at the maximum equator of the pinhole to generate. Moreover, this sealing approach is applied to a monotonous type separator. The passage of fuel gas or oxidizing agent gas is constituted combining the gas-passageway plate of another objects, such as carbon paper.
[0048] Corrosion resistance and conductive evaluation was performed by the same approach as an example 1. Consequently, the front face which corrosion was not seen at all but was stabilized was secured by the evaluation by 1000 hours like the example 1. It is shown that all the pinholes have been sealed with the roller press. Since sealing by the roller press is sealed for deposit itself, it cannot do the interface of dissimilar material but can expect stable and big corrosion resistance.
[0049] Contact resistance was 20m ohm-cm 2, and was the same value as the example of a comparison. Contact resistance was the same 20m ohm-cm 2 as the first stage also after the corrosion resistance test of 1000 hours. Although it became the same value as the example of a comparison since the area which a pinhole occupies was very small, contact resistance may become low from the example of a comparison in this case.
[0050] In addition, it is not limited to what was shown in the example 2 about the metallic material and the corrosion-resistant coat of a separator base material like an example 1. However, it is necessary to be the ingredient which has ductility as an ingredient of the corrosion-resistant coat of an example 2.
[0051] (Example 3) Drawing 5 is an explanatory view explaining the sealing process of the separator of an example 3. Aluminum 5052 was used as a metallic material of a separator base material. When a separator was aluminum, nickel-plating processing was carried out on the surface of aluminum, and gold plate processing was performed on it. It is generated in the phase of nickel plating and the pinhole has also produced the gold plate layer on it in the form where the pinhole of a nickel-plating layer is connected. This nickel-plating layer is not illustrated.
[0052] The separator 30 was immersed in the electrolytic solution 23 (15% sulfuric-acid solution) after washing by isopropyl alcohol. Next, temperature of the electrolytic solution 23 was made into 20 degrees C, and it anodized for 15 seconds with the current density of 1.5 A/cm2. The aluminum exposed to the electrolytic solution at the pinhole 12 was anodized by this anodizing, and the aluminum oxide was formed in this part of it. This aluminum oxide serves as the oxide skin 17 of a passive state.
[0053] Corrosion resistance and conductive evaluation was performed by the same approach as an example 1. Consequently, the front face which corrosion was not seen at all but was stabilized was secured by the evaluation by 1000 hours like the example 1. Since sealing of the pinhole was certainly carried out by the oxide skin 17, corrosion does not occur. Although the pinhole is very minute and it cannot view, sealing can be certainly carried out by anodic oxidation processed electrically.
[0054] Contact resistance was 20m ohm-cm 2, and was the same value as the example of a comparison. Contact resistance was the same 20m ohm-cm 2 as the first stage also after the corrosion resistance test of 1000 hours. The area which a pinhole occupies is very small, and since an oxide skin is not attached to any parts other than a pinhole, low contact resistance is maintainable.
[0055] In addition, it is not limited to what was shown in the example 3 about the metallic material and the corrosion-resistant coat of a separator base material like an example 1. Moreover, it may not be limited to what also showed the approach of oxidation treatment to the example 3, but the oxidizing [thermally] method by the elevated temperature etc. may be used.

[Translation done.]

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] The outline sectional view of the solid-state polyelectrolyte mold fuel cell cel of the example of this invention
[Drawing 2] The type section Fig. of the separator before sealing used for the example of this invention
[Drawing 3] The explanatory view explaining the sealing process of the separator of an example 1

[Drawing 4] The explanatory view explaining the sealing process of the separator of an example 2

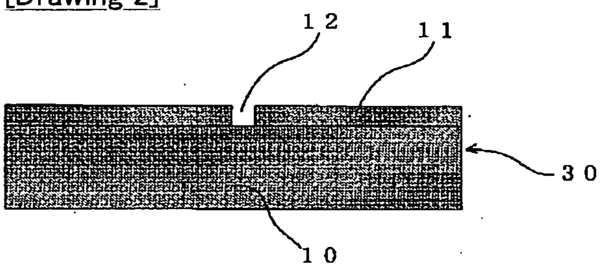
[Drawing 5] The explanatory view explaining the sealing process of the separator of an example 3

[Description of Notations]
1 -- Solid-state polyelectrolyte film (electrolyte)
2a -- Oxidizer pole (electrode)
2b -- Fuel electrode (electrode)
3a, 3b, 30 -- Separator
10 -- Separator base material
11 -- Gold plate layer (corrosion-resistant covering film)
12 -- Pinhole
15 -- Roller
16 -- Sealing section
17 -- Oxide skin
18 -- Acrylic polymer (resin)
20 -- Solid-state polyelectrolyte mold fuel cell cel (fuel cell)

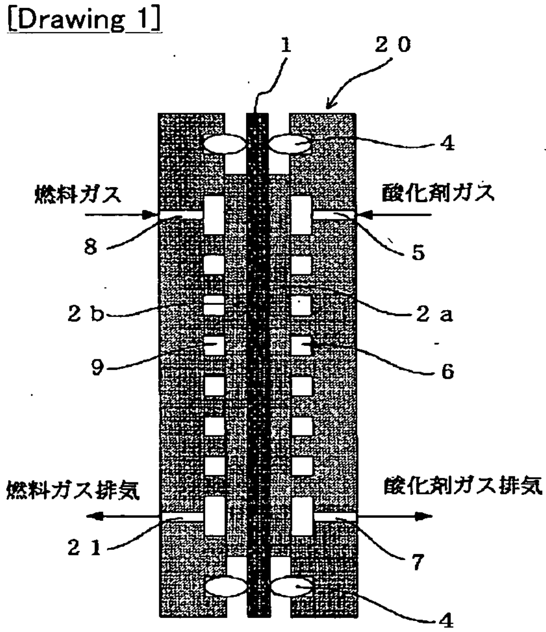
[Translation done.]

DRAWINGS

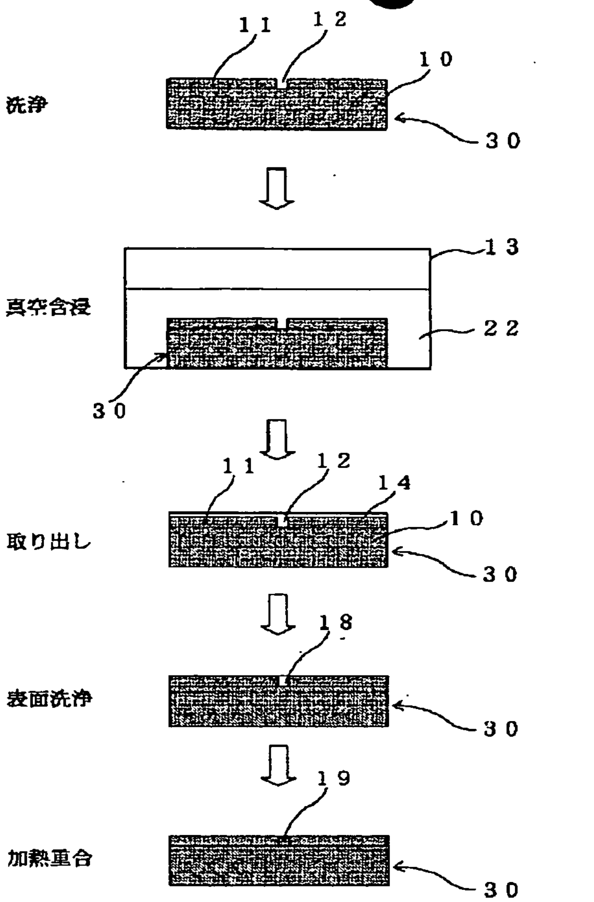
[Drawing 2]



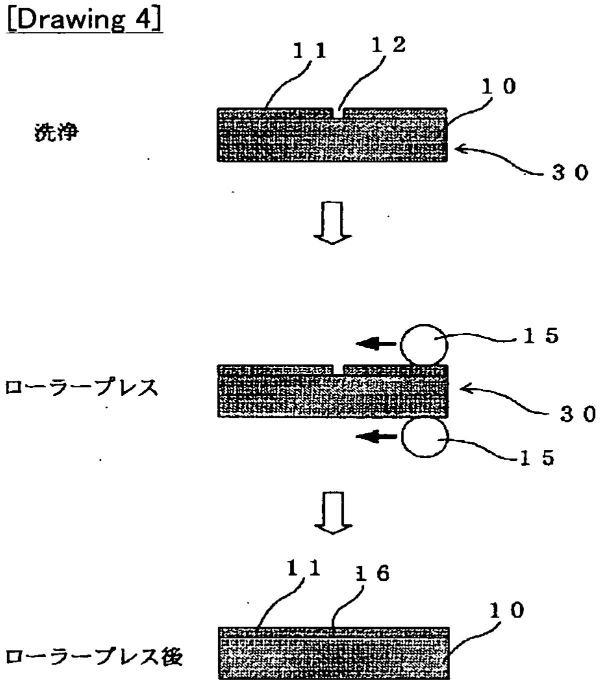
[Drawing 1]



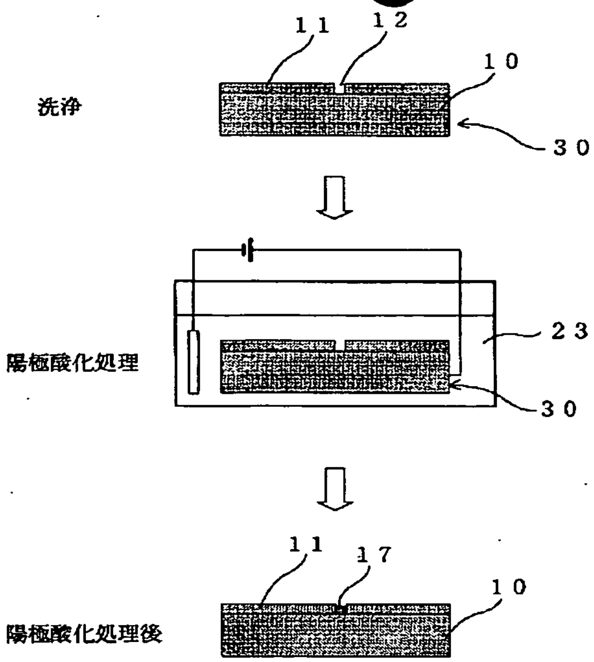
[Drawing 3]



[Drawing 4]



[Drawing 5]



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